TPS_RAYSTATION and measured planar doses Film_TOMO / Film_RAYSTATION was (0.3±0.2)%.

4 cases	γ evaluation (3%/3mm) TPS vs. Film		Absolute dose difference TPS vs. Ion Chamber		(C) Average γ difference (5%/5mm) TPS_{TOMO}/TPS_{RS} vs. $Film_{TOMO}/Film_{RS}$
	(A) Tomotherapy	(B) RayStation	(A) Tomotherapy	(B) RayStation	
Average	99,1%	99,5%	0,9%	-0,7%	0,3%
SD	0,6%	0,4%			0,2%

Table 1 - Gamma evaluation, absolute dose difference and average γ difference for all end-to-end tests.

Conclusion: Raystation fallback planning is an advanced feature that allows switching patient plans between alternative treatment machines and techniques. This could be useful to reduce impact of machine downtime on patient treatments. However, this process could introduce potential risks as distinct TPS and beam deliveries are involved. The results presented here show that a difference between calculated HT and mimicked RS fallback plans match the measured differences found throughout the end-to-end tests. Results based on a 5%/5mm tolerance show that we can expect at most 0.3% agreement from the difference between original and fallback plans displayed by the RS TPS. Further work will involve the study of clinical plans on various tumors sites.

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PRIMO software as a tool for Monte Carlo treatment quality control in IMRT: a preliminary study

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Purpose or Objective: Monte Carlo (MC) approach is considered the gold standard method to perform absorbed dose calculations in external radiotherapy[1], because it provides the most detailed and complete description of radiation fields and particle transport in tissues. Several codes are available and recently a new MC Penelope based code and graphic platform named PRIMO was developed [2]. PRIMO has a user-friendly approach, a suitable and competitive characteristic for clinical activity. Nevertheless, advanced features such as IMRT are not introduced yet. This work is a preliminary study for the PRIMO software as a tool for MC based quality control of IMRT treatment.

Material and Methods: The simulated beam parameters of a Varian CLINAC 2300 were adjusted based on measurements in a water tank for 6 MeV energy and 10x10 cm^2 field. The water tank was divided in 81x81x155 voxels with dimensions of 2x2x2 mm^3. The Gamma Function (GF) was used for agreement assessment and a phase-space was obtained above the MLC. A solid water phantom with a PTW OCTAVIUS® 729 2D ionization chamber array inserted was imaged by a CT scan and used in PRIMO. A dynamic IMRT plan was calculated by the Eclipse™ TPS and irradiated. The LINAC DynaLog files were analysed and the dynamic delivery was divided into series of static fields in PRIMO. MATLAB was used to analyse the PRIMO output and to create images of dose distributions at specific locations. The simulated dose at the ion chamber matrix position in the phantom was compared with the matrix measurement using the 2D GF through the PTW Verisoft program.

Results: The best agreement for the beam parameters of the LINAC numerical model was obtained with initial electron energy of 5.9±0.2 MeV and beam divergence of 1.5°. The gamma function analysis (2%, 2mm) showed that 97% of the points was lower than 1, confirming the good agreement with the experimental data. For the IMRT plan, the measured and simulated dose distributions at the ion chamber matrix (fig 1A-B) show good agreement, as the gamma points lower than 1 were 96% (fig 1C).

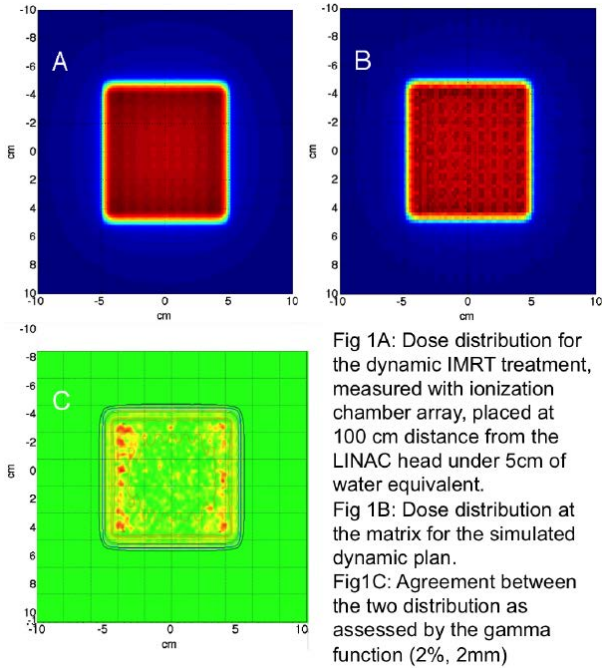

Fig 1A: Dose distribution for the dynamic IMRT treatment, measured with ionization chamber array, placed at 100 cm distance from the LINAC head under 5cm of water equivalent.
Fig 1B: Dose distribution at the matrix for the simulated dynamic plan.
Fig1C: Agreement between the two distribution as assessed by the gamma function (2%, 2mm)

Conclusion: This preliminary study shows that an IMRT plan was successfully simulated through PRIMO with acceptable concordance with the experimental results. Even though further studies on more complex treatments are still required, the results confirm PRIMO as a promising tool for IMRT simulation in clinical environment.

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Characterization of a new EPID-based system for in-vivo dosimetry in VMAT treatments

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Purpose or Objective: The aim of this paper is to evaluate the EPID detector sensitivity and specificity for in vivo dosimetry of VMAT treatments to identify dosimetric and geometric errors and anatomical variations.

Material and Methods: Measurements were performed by using TrueBeam STx accelerator equipped with EPID aSi1000 (Varian, Palo Alto, CA) and PerFraction (PF) software (Sun Nuclear Corporation, Melbourne, FL). PF is a commercial EPID-based dosimetry software, which allows performing transit dosimetry, to provide an independent daily verification of the treatment. Performance of the EPID detector and of the PF software on anthropomorphic phantom was studied, simulating 17 perturbations of the reference VMAT plan. Systematic variations in dose values (1%-5% output variation), shifts (2,5-11 mm in anterior direction), anatomical variations (adding bolus over phantom), and MLC positioning (locked leaf position for different arc extensions) were applied. The difference in local and global gamma pass rate (%GP) between the no-error and error-simulated measurements with 1%/1mm, 2%/2 mm and 3%/3 mm tolerances was calculated. The clinical impact of these errors was also analyzed through the calculation of the difference between the reference DVH and the perturbed DVH (%DE). We defined as clinically meaningful a variation higher than 3% between calculated and perturbated doses. A value of %GP equal to 95% and 90% and %DE equal to 3% were used as thresholds to calculate sensitivity and specificity.

Results: Repeatability and reproducibility of no-error measurements were excellent with %GP=100% for all gamma